Estimation of radiated energy of finite-source earthquake models

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We estimated seismically radiated energy for kinematic earthquake rupture models. Instead of integrating far-field waveforms, we used an expression for radiated energy with slip and stress on the fault plane. Using an analytic crack model of Sato and Hirasawa (1973), we show that the finite-difference method can estimate the radiated energy fairly well; however, if the rupture propagation velocity is near the S-wave velocity and the grid interval is coarse, we may underestimate the radiated energy substantially. We analyzed five models of three earthquakes of Mw 5-7. For the 1995 Kobe earthquake, we used three different kinematic models and obtained consistent values of radiated energy of 2.4-3.6 x 10**14 J. There are common features among the three models: 1) more efficient energy radiation from the deeper regions of fault, and 2) little energy radiation beneath the city of Kobe. The models of the Kobe earthquake and the other two earthquakes show that energy radiation is concentrated near the hypocenter and the initiation point of asperities. We also find the area of negative energy radiation, energy absorption, near the edge of large slipped areas. Although our estimates tend to be smaller by about a factor of three than previous estimates, the difference is reasonable because the frequency range is not complete and we cannot deal with detailed rupture behavior such as rapid rupture acceleration and deceleration.